Space Weather Technical Forecast

Issued on Thursday, 27 January 2022 at 12:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance G1/Minor Geomagnetic Storm, mainly day 2 or 3 (28th or 29th). Slight chance R1 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low through the last 24 hours, with a C1 flare from AR2936 Dai/Beta, and a B9 flare from AR2938 Bxo/Beta, both regions located in the northeast. AR2936 Dai/Beta remains the largest and most complex region on the visible disc at present. There are three small regions in the northwest, one numbered, two recently emerged and un-numbered. Two regions are located in the southern hemisphere, just west of centre disc, and although generally inactive a filament eruption was observed just to the north on the evening UTC of the 26th. A weak CME was observed and modelled and shows a possible glance around the 30th, but with low confidence. No other Earth-directed CMEs have been observed, however a notable CME was observed in imagery from a far-sided eruption.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 has fluctuated between 440-520km/s. Peak winds occurred on the evening UTC of the 26th and have declined since. The density was average. The total field strength (IMF) Bt, varied 2-8nT. The north-south component, Bz, remained weak and variable ranging between +5nT and -5nT. Phi angle was generally positive (away from the Sun), but with some brief negative fluctuations. Geomagnetic Activity remain Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV), was at background to moderate levels. The associated electron fluence was below the Active threshold, with 1.77e6 recorded at 27/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low. There are five numbered sunspot regions on the Earth-facing disc, with a slight chance of activity increasing to Moderate, primarily from AR2936 and AR2938, both in the northeast.

Solar Wind / Geomagnetic Activity: There is one CME on the Earth-Sun line that has been assessed, but currently expected to pass over Earth around 29/0000 UTC, although a glancing impact cannot be ruled out. A further weak CME may glance Earth on the 30th, but this is low confidence. Waning fast wind influence of CH46 is expected to decline further on day 1 (27th) before the arrival of a further fast wind enhancement from CH47 on day 2 (28th). Solar winds are expected to become elevated again, likely around 550km/s, before gradually easing later day 3 and day 4 (29th and 30th). Geomagnetic activity is forecast to Quiet to Unsettled day 1 (28th), increasing to Unsettled to Active with onset of the fast winds of CH47 day 2 (28th) with a slight chance of G1/Minor Storm interval mainly due to any glancing CME impact. Activity then easing to be mainly Quiet to Unsettled by late day 3 and day 4 (29th and 30th), although any further CME glancing influence continues to carry a slight chance of a brief Active or G1 period.

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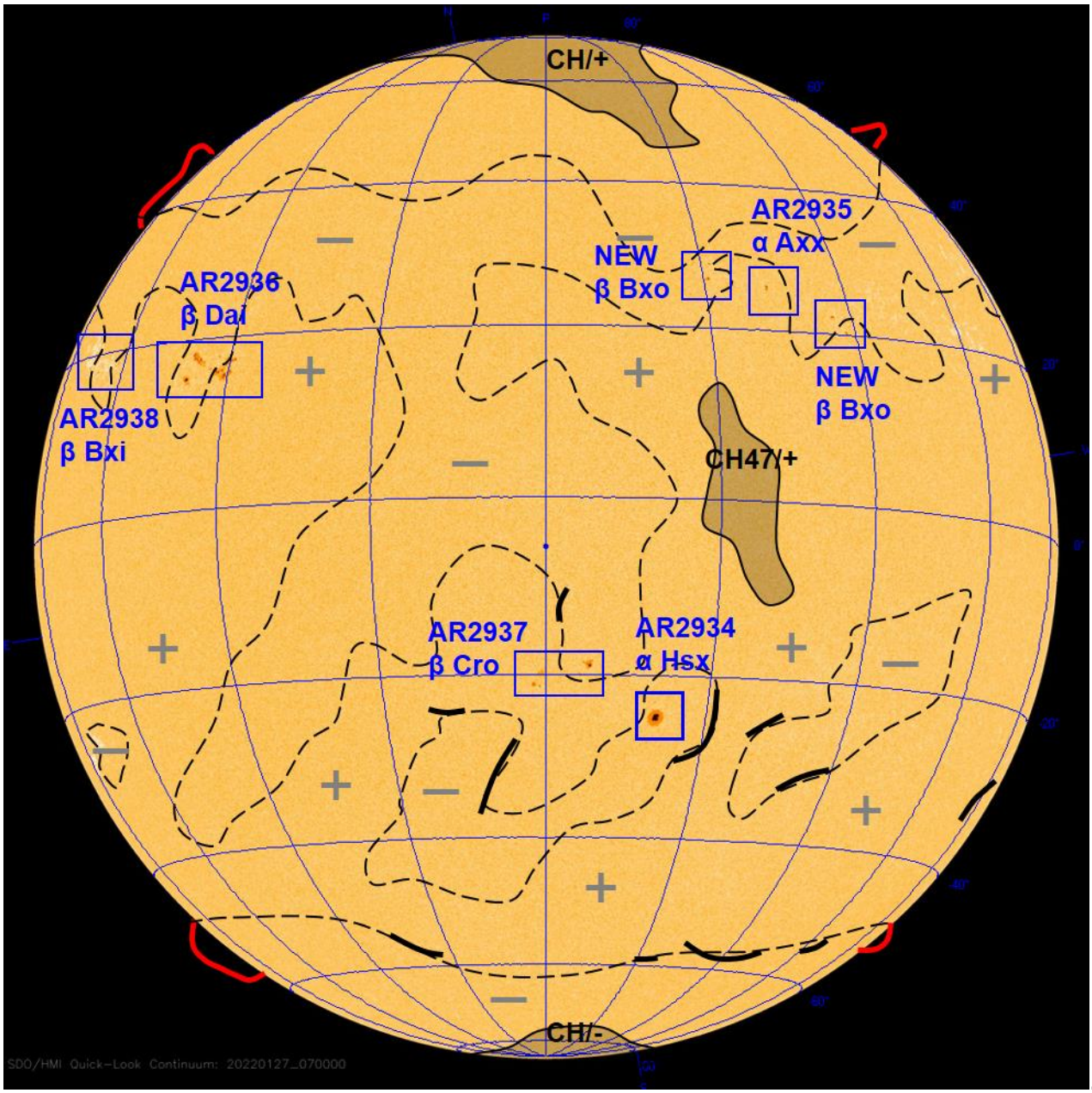
Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to remain at background levels. The high energy electron flux (greater than 2MeV) is currently at background levels. There is the potential for this to rise to Moderate, perhaps peaking high levels, perhaps briefly day 1 (28th), but mainly by the end of the period as enhanced winds ease. The associated 24hr fluence has only a slight chance of reaching the Active threshold by the day 4 (30th).

Figure 1. Solar Analysis Valid 27/0730 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one CME currently expected to pass near Earth during the forecast period, however the bulk of this CME is forecast to miss passing north of the Earths orbital plane. This was from a filament eruption on the 24th, potentially associated with a C2-flare. This has a slight chance of glancing influence around 29/0000UTC. A filament eruption at 26/1945 UTC, from near AR2934, has been modelled and could give an Earth-directed glance on the 30th, although this is low confidence.

Earth is currently in the waning influence of CH46,with solar winds having decreased to slightly elevated levels. Solar winds are expected to ease a little further through day 1 (27th) before the potential arrival of the fast wind of CH47, likely on day 2 (28th). Similar strength winds are possible to the current fast wind enhancement, perhaps peaking around 550 km/s. This is in-line with expectations from persistence, and also timings of an enhancement seen in STEREO A PLASTIC data, although this is contaminated with a CME arrival. Solar winds are expected to ease again day 4 (30th) onward.

Geomagnetic activity is forecast to Quiet to Unsettled day 1 (28th), increasing to Unsettled to Active with onset of the fast winds of CH47 day 2 (28th) with a slight chance of G1/Minor Storm interval mainly due to any glancing CME impact. Activity then easing to be mainly Quiet to Unsettled by late day 3 and day 4 (29th and 30th), although any further CME glancing influence continues to carry a slight chance of a brief Active or G1 period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	20	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/0220	Partial	Filament	N23 E001	376	29/0000 UTC	Likely missing but low chance

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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Solar Activity is currently Low, with the main activity from the regions in the northeast, AR2938 and AR2936. There are five numbered sunspot regions. 2936 (Beta/Dai) is the largest and most complex, with further intermediate spot development observed. 2937 (Cro/Beta) has changed little in recent hours, whilst 2934 nearby has persisted as a simple Hsx/alpha region. 2935 is a single small Alpha/Axx spot, however two new regions have developed to the east and west, currently just small Bxo groups. 2938 has shown minor spot emergence.
Low solar activity is expected to continue, with a slight chance of isolated Moderate flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	15	15	15	15
Very Active	**R3 to R5 X Class**	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. No solar radiation storms are expected in the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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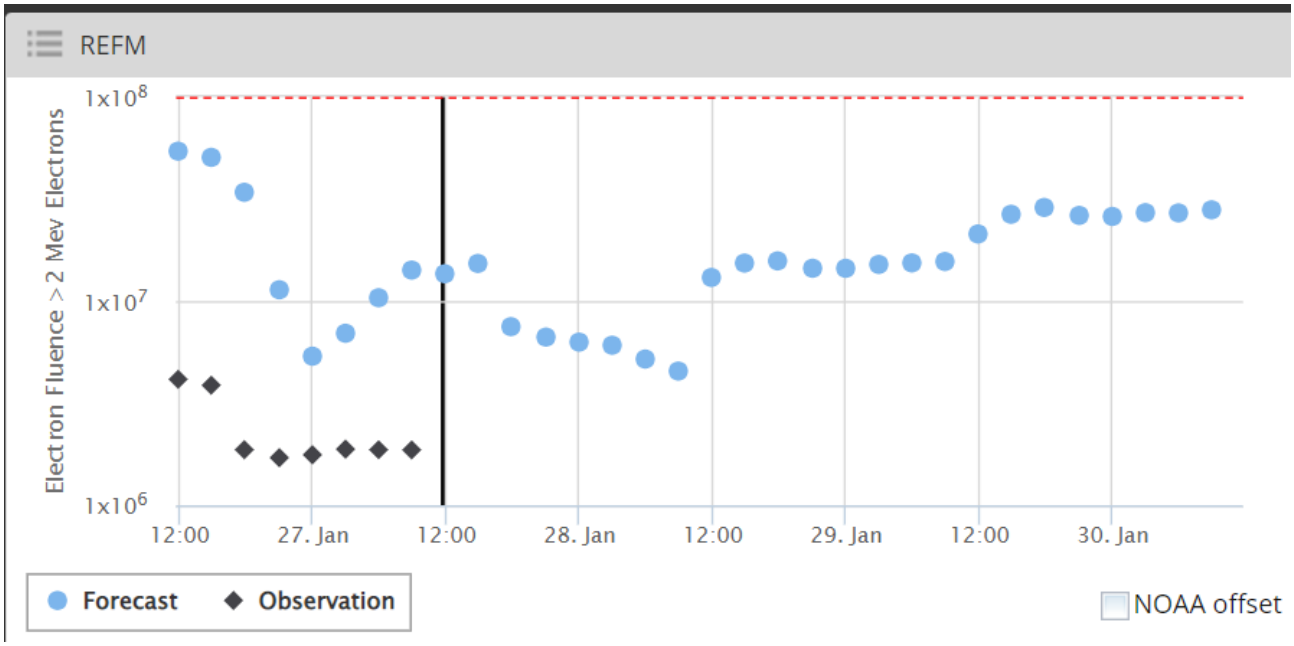
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 at GEO is currently at background. This has the potential to rise as solar winds ease day 1 (28th), but is likely to be suppressed again by the onset the fast wind of CH47 day 2. Given the limited strength from either of these enhancements, coupled with the limited electron response observed from CH47 on the previous rotation, flux levels are expected to only rise to be generally Moderate, with a chance of peaking diurnally at High.

With only a limited flux response anticipated from either fast wind enhancement, the associated 24hr fluence is expected to remain below the Active (1e8 integrated pfu) level. A slight, and increasing chance is maintained however, as there will be a potential for fluence to increase as solar winds ease later in the period. REFM, whilst currently giving a noisy signal, supports fluence levels remaining below the Active period, and is considered to be giving good guidance at this stage despite not taking account of the potential fast wind arrival.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM.



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